REISSUE LITIGATION

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REISSUE LITIGATION
Raymond Degner et al.
Reissue Appln. 10/734,073 Filed Dec. 12, 2003
For: COMPOSITE ELECTRODE FOR PLASMA
Protester: Xycarb Ceramics, Inc.
Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

Fax

To:	Director, Technology Center 1700 Group Art Unit 1744	**From:**	John E. Wagner, Reg. No. 17496
Company:	USPTO	**Pages:**	29 (Including cover sheet)
Fax:	703 872-9306	**Date:**	May 10, 2004
Re:	Protest to the Reissue of U.S. Patent 5,074,456.	**Our Docket:**	01-9665-06.4

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply**

Enclosed is the Protest of Xycarb Ceramics, Inc. under 37 CFR 1.291(a) to the Reissue of U.S. Patent, 5,074,456. The full copy, including all references, are filed this day at the Customer window by our Washington associate, Dennis Kreps, 703 413-6616, who attempted delivery to the Technology Center in accordance with the rules for Protest filing in litigation. Enclosed herewith are the following excerpts from the full Protest:

Protest	(6 pages)
Information Disclosure Statement	(1 page)
First page of References A-K	(14 pages)
Listing of Claim Comparison Sheets	(5 pages)
Proof of Service On Opposing Counsel	(2 page)

An additional copy is being faxed to SPE Tom Dunn at Fax 571/273-1171.

John E. Wagner

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Patent
Attorney Docket No. 01-9665-06.4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Patent Application of	
Raymond DEGNER et al.	
Application No.: 10/734,073 (Reissue)	Group Art Unit: 1744
Filed: December 12, 2003	Examiner (Unknown)
For: COMPOSITE ELECTRODE FOR PLASMA PROCESSES	Status: Published March 9, 2004
	Attention: Director, Technology Center 1700

PROTEST OF XYCARB CERAMICS, INC. UNDER 37 C.F.R. 1.291(a) TO THE REISSUE OF U.S. PATENT 5,074,456

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Xycarb Ceramics, Inc., a Texas corporation, with a principal place of business at 101 Inner Loop Road, Georgetown, Texas 78626, hereby protests the reissue application of U.S. Patent 5,074,456, (hereinafter Degner '456 Patent) by its owner of record, LAM Research Corporation. The Protest extends to the unpatentability of all 36 claims of the reissue application, in view of the prior art accompanying this Protest. The Degner '456 Patent, as noted in the Reissue Application, is the subject of litigation

REISSUE LITIGATION

between the parties to this Protest in the U.S. District Court, Northern District of California, Case 3:03-cv-01335.

Enclosed is Protester's Information Disclosure Statement (PTO 1449) listing 11 U.S. patents and 1 publication which, individually or in various combinations, are believed to clearly render each of the claims of the Degner '456 Patent invalid under 35 U.S.C. 102(b), 103 or 112, 2nd paragraph. Copies of the 11 patents, along with a reproduction of the cover title page, copyright page, introductory pages, and Chapter 5 of the book McGuire, SEMICONDUCTOR MATERIALS AND PROCESS TECHNOLOGY HANDBOOK, For Very Large Scale Integration (VLSI) and Ultra Large Scale Integration (ULSI), © 1988, are enclosed as prior art references A-K.

A concise explanation of the relevance of each listed prior art reference is presented in the attached CLAIM COMPARISON SHEETS. Each CLAIM COMPARISON SHEET reproduces one or more claims of the Degner '456 Patent on the left-hand side, with the relevant language of each prior art reference and corresponding marked-up drawings on the right-hand side, along with the Protester's conclusions or reasons for the relevance.

The reason for combining more than one claim of the Degner '456 Patent on one sheet or a series of sheets is the fact that the claims are so numerous in the patent that

many of them, mainly the dependent claims, are identical or nearly identical in content. For example, claims 2 through 17 are dependent upon claim 1, and claims 19 through 32 are dependent upon claim 18, but the contents of these two dependent series of claims are identical or nearly identical. This form of presentation is believed to facilitate the necessary examination of all these claims.

It is noted that only two claims of the Degner '456 Patent, 18 and 33, were indicated by the Reissue Applicant to be involved and requiring reexamination in the reissue process. Those two claims, 18 in particular and 33, as now admitted to be invalid, are the principal claims being asserted by the Reissue Applicant in the District Court litigation, along with all of the other claims of the Degner '456 Patent.

CONSIDERATION OF PROTESTOR'S ARGUMENTS PER MPEP 1901.06

Protestor submits herewith Attachments I, II, III and IV, which are documents filed by the Reissue Applicant, LAM Research Corporation, in the pending District Court, litigation referenced above. These include clear judicial admissions by the Reissue Applicant of the particular pertinence of U.S. Patent 4,385,979 to Pierce et al (hereinafter Pierce '979 Patent). The Reissue Applicant asserted in the litigation that the Pierce '979 Patent clearly teaches shrink fitting of an electrode to its support for use in plasma processing systems. This admission clearly invalidates claims 1, 18, 33, 34,

35, and 36 of the Degner '456 Patent.

A further need for the careful review of each of the claims of the Degner '456 Patent is the fact that the Reissue Applicant is asserting vigorously in the pending District Court litigation that the Degner '456 Patent discloses and claims "bonding" of the electrode to its supporting ring "may be by any suitable process", including shrink fit. See Attachment III, Page 5, lines 4-28. That interpretation flies in the face of the numerous prior art references, References A-K, provided by the Protester, which reflect the many forms of electrode bonding well known in exactly the same art before the Reissue Applicant's perceived invention.

The only difference between the Degner '456 Patent and the Pierce '979 Patent is that in the Degner '456 Patent, the electrode is of substantially uniform thickness, whereas in the Pierce '979 Patent, the electrode is shaped. In this field, flat electrodes are typically used in etching systems, whereas shaped electrodes are used in deposition systems. However, Degner '456 Patent states that its electrode bonding system may be used in either etching or deposition systems. See Degner '456 patent, Abstract, sentence 1 and Col. 1, lines 6-11.

As a further ground for this Protest, it is submitted that the error in claim 18, which gives rise to the Reissue Application, and the error in claim 33, likewise amended

to overcome an error, were of the type that were apparent on their face as soon as the Degner '456 Patent issued in 1991. Thirteen years later Reissue is sought. The Reissue Applicant brought suit for infringement and asserted claim 18 vigorously as enforceable at least six months before this Reissue Application was filed. At that time, the Reissue Applicant relied upon the Pierce '979 Patent in reality to support a broadened claim construction covering any form of bonding of plasma electrodes to their support, well beyond the two-year limit for a broadening reissue. The Pierce '979 Patent, our Ref. A, is believed to invalidate claim 18 as well as all other claims under 35 U.S.C. 102(b) alone or under 35 U.S.C. 103 in combination with the other references cited by the Protester.

In this Protest, relevant prior art patents are identified by the full patent number and name on the Information Disclosure Statement. Thereafter, they are also designated by Protester's reference designations of Ref. A and C through K, as well as inventor's name and last three digits of the patent number, for example, Ref. A Pierce et al. '979.

References to rejection of several claims under 35 U.S.C. 112 are indicated to mean that the claims lack definiteness or are unallowable Markush-type claims, for example, claims 16, 30, and 35. MPEP 2173.05 (h) or original claims 18 and 33 MPEP 2173.05(a).

REISSUE LITIGATION

It is requested that in Reissue prosecution, that the Examiner carefully considers References A-K, apply them to the claims and reject claims 1-36 of the Degner '456 Patent.

Respectfully submitted,

John E. Wagner 5/8/04

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Enclosures:

I:\Lit\Xycarb\Lam\06.4.PROTEST

INFORMATION DISCLOSURE CITATION

(Use several sheets if necessary)

Docket Number (Optional)	Application Number
01-9665-06.4	10/734,073
Applicant(s)	
Degner et al.	
Filing Date	Group Art Unit
Dec. 12, 2003	Unknown

U.S. PATENT DOCUMENTS

*EXAMINER INITIAL	REF	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	A	4,386,979	5/31/83	Pierce et al.	204	298	
	B	See Below					
	C	4,564,435	1/14/86	Wickersham	204	298	
	D	4,931,135	6/5/90	Horiuchi et al.	156	643	
	E	4,820,371	4/11/89	A. D. Rose	156	345	
	F	4,904,621	2/27/90	Loewenstein	437	225	
	G	4,367,114	1/4/83	Steinberg et al.	156	643	
	H	4,297,162	10/27/81	Mundt et al.	156	643	
	I	4,963,713	10/16/90	Horiuchi et al.	219	121.45	1/18/99
	J	4,792,378	12/20/88	Rose et al.	156	643	
	K	4,544,091	10/1/85	Hidler et al.	228	124	

FOREIGN PATENT DOCUMENTS

	REF	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	Translation YES	Translation NO

OTHER DOCUMENTS *(Including Author, Title, Date, Pertinent Pages, Etc.)*

	REF	
	B	McGuire, SEMICONDUCTOR MATERIAL AND PROCESS TECHNOLOGY HANDBOOK, FOR VERY LARGE SCALE INTEGRATION (VLSI) AND ULTRA LARGE SCALE INTEGRATION (ULSI), Copyright 1988, Noyes Publications, Chapter 5, Particularly Pages 272-279, Fig. 51aiii

EXAMINER	DATE CONSIDERED

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

REISSUE APPLICATION

CLAIM COMPARISON SHEETS

Concise Descriptions of Relevance Are Found On Each Claim Comparison Sheet

REFERENCES AND BASES FOR REJECTION

1.	Claims 1 and 18	Ref. A Pierce '979 (Figs. 3a, 3b, and 3c) 35 U.S.C. 102 (b) or 103 (electrode not flat)
2.	Claims 1 and 18	Ref. A Pierce '979 (Figs. 4a, 4b, 5, and 6 plus Ref. B McGuire 35 U.S.C. 103
3.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. D Horiuchi '135 (Fig. 1) 35 U.S.C. 103
4.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. D Horiuchi '135 (Fig. 14) 35 U.S.C. 103
5.	Claims 1 and 18	Ref. G Steinberg '114 35 U.S.C. 102(b)
6.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. H Mundt '162 35 U.S.C. 103
7.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. I Horiuchi '713 (Fig. 1) 35 U.S.C. 103 or 102
8.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. I Horiuchi '713 (Fig. 6) 35 U.S.C. 103
9.	Claims 1 and 18	Ref. A Pierce '979 and/or Ref. J Rose '378 (Fig. 1) 35 U.S.C. 103 or 102(b)
10.	Claims 1 and 18	Ref. A Pierce '979 plus Ref. K Hidler '091 (Figs. 1 and 2) 35 U.S.C. 103

REISSUE APPLICATION

11.	Claim 2	Ref. D Horiuchi '135 (Figs. 1 and 14) 35 U.S.C. 102(b) or 103
12.	Claim 2	Ref. I Horiuchi '713 (Figs. 1 and 6) 35 U.S.C. 102(b) or 103
13.	Claim 2	Ref. G Steinberg et al. '114 35 U.S.C. 102(b) or 103
14.	Claims 3, 4 and 19	Ref. B McGuire or Ref. D Horiuchi '135 (Fig 1)
15.	Claims 3, 4 and 19	Ref. D Horiuchi '135 (Fig. 14) or Ref. F (Fig. 30c) 35 U.S.C. 103
16.	Claims 3, 4 and 19	Ref. H Hidler '091 (Figs. 4 and 5) 35 U.S.C. 103
17.	Claims 3, 4 and 19	Ref. I Horiuchi '713 (Figs. 1 and 6)
18.	Claim 5	Ref. A Pierce '979 (Figs. 3a, 3b, and 3c) Ref. B (Fig. 51aiii) 35 U.S.C. 102(b) or 103
19.	Claim 5	Ref. A Pierce '979 (Figs. 4a, 4b, particularly 5 and 6) 35 U.S.C. 102(b) or 103
20..	Claim 5	Ref. B McGuire (Figs 3a, 3b and 3c; Fig. 51aiii) 35 U.S.C. 103
21.	Claim 5	Ref. C Wickersham (Figs. 1, 2 and 3) 35 U.S.C. 103
22.	Claim 5	Ref. D Horiuchi '135 (Figs. 1 and 14) 35 U.S.C. 102(b)
23.	Claim 5	Ref. F Loewenstein '621 (Fig. 30c) 35 U.S.C. 103
24.	Claim 5	Ref. I Horiuchi '713 (Figs 1 and 6) 35 U.S.C. 102(b) or 103
25.	Claims 6 and 20	Ref. C Wickersham '435 (Figs. 1, 2 and 3) 35 U.S.C. 102(b) or 103

REISSUE APPLICATION

26. Claims 7 and 21 Ref. A Pierce '979 (Figs. 3a, 3b, and 3c)
35 U.S.C. 102(b) or 103

27. Claims 7 and 21 Ref. A Pierce '979 (Figs 4a and 4b)
35 U.S.C. 102(b) or 103

28. Claims 7 and 21 Ref. D Horiuchi '135 (Figs. 1 and 14)

29. Claims 7 and 21 Ref. G Steinberg '114 (The figure) 35 U.S.C. 102(b)

30. Claims 8 and 22 Ref. F Loewenstein '621 or Ref. H Mundt '162 (see chart)
35 U.S.C. 103 or 112

31. Claims 8 and 22 Ref. I Horiuchi '713 (see chart) 35 U.S.C. 103 or 112

32. Claims 8 and 22 Degner '456 admissions, Col. 4, lines 21-25l 35 U.S.C. 112

33. Claims 9 and 23 Degner '456 admissions, Col. 5, lines 18-23 35 U.S.C. 112

34. Claims 10 and 24 Ref. A Pierce '979, Figs. 3a-6, Elements 215, 315, 415, 515, and 615 35 U.S.C. 103

35. Claims 10 and 24 Ref. K Hidler '091, Figs. 1 and 2 bonding layer 16
35 U.S.C. 102(b) and 103

36. Claims 11 and 25 Ref. A Pierce '979 alone or with Ref. K, Hidler '091 (see chart) 35 U.S.C. 102(b) or 103

37. Claims 12, 25 and 26 Ref. A Pierce '979 (see chart)
35 U.S.C. 102(a) or 103

38. Claims 12, 25 and 26 Ref. K Hidler '091, (Figs 1 and 2) 35 U.S.C. 103

39. Claims 13 and 27 Ref. A Pierce '979 35 U.S.C. 102(b) or 103

REISSUE APPLICATION

40.	Claims 13 and 27	Ref. C, D and K (See Chart) 35 U.S.C. 102.(b) or 103
41.	Claims 14 and 28	Ref. K Hidler '091 (Figs. 1 and 2, Col. 2, lines 29-61) 35 U.S.C. 102(b)
42.	Claims 15 and 29	Ref. A Pierce '979, (Col. 11, line 44 through Col. 12, line 5) 35 U.S.C. 102(b) or 103
43.	Claims 15 and 29	Ref. K Hidler '091 (Figs. 1 and 2 plus Col. 3, lines 24-50) 35 U.S.C. 102(b) or
44.	Claims 16 and 30	Ref. A Pierce '979 (Col. 2, lines 29-32 and Col. 12, Lines 6-14) 35 U.S.C. 112, 102(b) or 103
45.	Claims 16 and 30	Ref. D Horiuchi '135 (see chart) 35 U.S.C. 112, 102(b) or 103
46.	Claims 16 and 30	Ref. F Loewenstein '621 (Col. 54, lines 33-36) 35 U.S.C. 112, 102(b) or 103
47.	Claims 16 and 30	Ref. G Steinberg '114 (The Fig. and Col. 2, lines 57-60) 35 U.S.C. 112, 102(b) or 103
48.	Claims 17 and 31	Ref. A Pierce 979 Ref. C Wickersham '435 Ref. D Horiuchi '135 (see Chart) 35 U.S.C. 102(b) and 112
49.	Claims 17 and 31	Ref. A Pierce '979 Ref. F Loewenstein '621 Ref. D Horiuchi '135 (see chart) 35 U.S.C. 102(b) and 112
50.	Claim 32	Re. A. Pierce '979 (see chart) 35 U.S.C. 102(b)

REISSUE APPLICATION

51.	Claim 32	Ref. C Wickersham '435 (see chart) 35 U.S.C. 102(b)
52.	Claim 33	Re. A. Pierce '979 (see chart) 35 U.S.C. 102(b)
53.	Claim 34	Ref. A Pierce '979 (Col. 13, line 67 through Col. 14, line 14 .particularly Col. 14, lines 8-14) 35 U.S.C. 102(b)
54.	Claim 35	Ref. A Pierce '979, Col. 2, lines 29-31, Col. 12, lines 6-14 35 U.S.C. 102(b)
55.	Claim 35	Ref. D Horiuchi '135, Col. 12, lines 57-60 35 U.S.C. 102(b)
56.	Claim 35	Ref. F Loewenstein '621 Col. 54, lines 33-36 35 U.S.C. 102(b), 112
57.	Claim 35	Ref. G Steinberg '114, Col. 3, lines 60-63, 35 U.S.C. 102(b) 103, or 112
58.	Claim 36	Ref. A, Pierce et al. '979, Col. 13, line 67, Col. 14, line 28, and Figs. 3a, 3b, 3c, 4a, 4b, and particularly Figs. 5 and 6 35 U.S.C. 102(b)
59.	Claim 36	Ref. C Wickersham '435, Col. 6, lines 6-15, Figs. 2 and 3 35 U.S.C. 102(b)

I:\lit\xycarb\lam\06.4.CLAIM COMPARISON SHEETS.doc

PROOF OF SERVICE

I, the undersigned, certify that I am a patent agent associated with the LAW OFFICES OF JOHN E. WAGNER; that I am over eighteen years of age and not a party to the within action; and that my business address is KM ASSOCIATES, 2001 Jefferson Davis Highway, Suite 312, Arlington, VA 22202.

I served the following documents:

1. This transmittal letter with Deposit Account Authorization
2. Power of Attorney
3. Protest Under CFR 1.291(a) (6 pages)
4. Information Disclosure Statement (1 page)
   - Ref. A 4,385,979 Pierce et al.
   - Ref. B publication McGuire (excerpts)
   - Ref. C 4,564,435 Wickersham
   - Ref. D 4,931,135 Horiuchi
   - Ref. E 4,820,371 Rose
   - Ref. F 4,904,621 Loewenstein
   - Ref. G 4,367,114 Steinberg
   - Ref. H 4,297,162 Mundt
   - Ref. I 4,963,713 Horiuchi
   - Ref. J 4,792,378 Rose
   - Ref. K 4,544,091 Hidler
5. Copies of Refs. A-K on the Information Disclosure Statement above
6. Attachments I, II, and III from Case 3:03-cv-01335 Northern District of California
7. Declaration of JW verifying authenticity of Attachments I, II, III, and IV
8. Attachment I
   SUPPLEMENTAL DECLARATION OF PATRICK MICHAEL IN SUPPORT OF LAM RESEARCH CORPORATION'S APPLICATION FOR TEMPORARY RESTRAINING ORDER
9. Attachment II
   LAM RESEARCH CORPORATION'S REPLY BRIEF IN SUPPORT OF APPLICATION FOR TEMPORARY RESTRAINING ORDER TO ENJOIN XYCARB CERAMICS FROM INFRINGING PATENT '456
10. Attachment III
    LAM RESEARCH CORPORATION'S APPLICATION FOR TEMPORARY RESTRAINING ORDER TO ENJOIN XYCARB CERAMICS, INC. FROM INFRINGING PATENT '456
    Attachment IV
    McGraw Hill SCIENTIFIC DICTIONARY
11. Listing of CLAIM COMPARISON SHEETS
12. CLAIM COMPARISON SHEETS (57 sheets)
13. Proof of Service on Opposing Counsel

on the parties stated below, through their attorneys of record, by placing a true copy thereof in a sealed envelope addressed as shown below by the following means of service:

__X__: By First Class Mail – I am readily familiar with the firm's practice for collection and processing of correspondence for mailing. Under that practice, the correspondence is deposited with the United States Postal Service on the same day as executed, with first-class postage thereon fully prepaid, in Alexandria, Virginia, for mailing to the office of the addressee following ordinary business practices.

Addressee

Peter K. Skiff
Bums, Doane, Swecker & Mathis, L.L.P.
P.O. Box 1404
Alexandria, VA 22315-1404

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 10, 2004, at Arlington, VA.

Dennis Kreps
Dennis Kreps

KLBX\carol\...PROOF OF SERVICE

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MAY 10 2004

REISSUE LITIGATION

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(818) 957-3340

Fax

PART 2 of fax transmission (15 pages) plus copy of coversheet (16 pages total)

To:	Director, Technology Center 1700 Group Art Unit 1744	**From:**	John E. Wagner, Reg. No. 17496
Company:	USPTO	**Pages:**	29 (Including cover sheet)
Fax:	703 872-9306	**Date:**	May 10, 2004
Re:	Protest to the Reissue of U.S. Patent 5,074,456.	**Our Docket:**	01-9665-06.4

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Protester: Xycarb Ceramics, Inc.
Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

United States Patent [19]

Pierce et al.

[11] 4,385,979
[45] May 31, 1983

[54] **TARGET ASSEMBLIES OF SPECIAL MATERIALS FOR USE IN SPUTTER COATING APPARATUS**

[75] Inventors: Danny A. Pierce, Columbus; Joseph A. Heisler, Timberlake; Roger D. Self, Mount Sterling, all of Ohio

[73] Assignee: Varian Associates, Inc., Palo Alto, Calif.

[21] Appl. No.: 396,880

[22] Filed: Jul. 9, 1982

[51] Int. Cl.³ C23C 15/00
[52] U.S. Cl. 204/298
[58] Field of Search 204/298

[56] References Cited

U.S. PATENT DOCUMENTS

3,730,823	5/1973	Carpenter	204/298
3,878,085	4/1975	Corbani	204/298
4,009,090	2/1977	Veigel	204/192
4,038,171	7/1977	Moss et al.	204/298
4,100,055	7/1978	Rainey	204/298
4,169,031	9/1979	Brors	204/298
4,198,283	4/1980	Class et al.	204/298
4,219,397	8/1980	Clarke	204/298

OTHER PUBLICATIONS

J. L. Vossen and W. Kern, "Thin Film Processes", 1978, pp. 31–33, 41–42 and 138–141, Academic Press, New York.

J. van Esdonk and J. F. M. Janssen, "Joining a Sputtering Target and a Backing Plate", Jan. 1975, pp. 41–44, Research/Development.

Primary Examiner—Arthur P. Demers
Attorney, Agent, or Firm—Stanley Z. Cole; Leon F. Herbert; Robert L. Jepsen

[57] ABSTRACT

In high rate sputter coating sources, it is generally necessary to liquid cool the sputter targets. In one type of source, a cooled wall of a cathode assembly is closely adjacent a sidewall of the sputter target. During normal operation the sidewall of the target expands thermally into tight contact with the cooled wall, whereby cooling of the target is affected without the need for bonding the target to the cooled wall using a solder or other adhesive. Thus, replacement of worn conventional targets is a relatively simple procedure. When the targets are made of certain special materials, such as fragile materials or materials with low coefficients of thermal expansion, target warping, cracking or melting can occur. Such problems are overcome or alleviated by the novel design approach of the present invention, which employs a sputter target assembly in place of a conventional target. The novel sputter target assembly comprises a sputter target of the special material, a retaining member, and a bonding means between the special sputter target and the retaining member. When the special target is worn out, the sputter target assembly is replaced with the same simple procedure used for a conventional target.

13 Claims, 11 Drawing Figures

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For: COMPOSITE ELECTRODE FOR PLASMA
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MATERIALS SCIENCE AND PROCESS TECHNOLOGY SERIES

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McGuire

SEMICONDUCTOR MATERIALS AND PROCESS TECHNOLOGY HANDBOOK

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SEMICONDUCTOR MATERIAL AND PROCESS TECHNOLOGY HANDBOOK

for

Very Large Scale Integration (VLSI)
and
Ultra Large Scale Integration (ULSI)

Edited by
Gary E. McGuire

NOYES PUBLICATIONS

Table 4b: PECVD of Semiconductors, Conductors, and Elements

Material Deposited	Reactants	Reference
amorphous silicon, a-Si(H)	SiH_4 Si_2H_6	246, 256 261
polycrystalline silicon	SiH_4	278
epitaxial silicon	SiH_4	281
amorphous germanium, a-Ge(H)	GeH_4	323
epitaxial germanium	GeH_4	285
epitaxial GaAs	Ga, As $(CH_3)_3Ga$, AsH_3	286 287
epitaxial GaSb	Ga, Sb	288
amorphous carbon, a-C(H)	C_4H_{10} C_2H_2	186, 324 325
amorphous boron, a-B(H)	B_2H_6 BCl_3, H_2 BBr_3, H_2	326 327 328
amorphous arsenic, a-As(H)	AsH_3	329
aluminum	$AlCl_3$ $(CH_3)_3Al$	290 290
tungsten	WF_6, H_2	292
molybdenum	MoF_6, H_2 $MoCl_5$, H_2 $Mo(CO)_6$	292 294 293
tungsten silicide	WF_6, SiH_4	295
molybdenum silicide	$MoCl_5$, SiH_4	294
titanium nitride	$TiCl_4$, N_2, H_2	304
tin oxide	dibutyltin diacetate $(CH_3)_4Sn$, N_2O	316

REISSUE LITIGATION
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Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

Table 5: Variable Parameters in PECVD

Direct Variables:

Parameter	Typical Value
Reactant Gas Flows	1-1000 sccm
Reactant Gas Flow Ratios	1-100
Total Gas Flow (also gas flow pattern)	50-5000 sccm
Electrode Spacing	2-4 cm
Gas Pressure	200-2000 mtorr
RF Power Density	0.03 - 0.5 W cm^{-2}
RF Frequency	25 KHz - 25 MHz
Substrate Temperature	200 - 400 °C

Resultant Variables:

Deposition Rate
Film Composition
Uniformity of Rate and Composition
Film Properties

Similar situations in plasma etching are being treated by Mocella et al.[129] using the statistical technique of Response Surface Methodology to generate a model parametric expression of the process. Such an approach has the potential to drastically reduce the number of experimental data points needed to optimize a multi-parameter process, and therefore its application to PECVD would be very beneficial. Thus deposition parameters may be selected to optimize a specific film property for a given processing application, and the sensitivity of that property to small variations in each parameter established in order to determine the necessary levels of parameter control.

4.2.1 Reactor Designs. All plasma deposition systems consist of the following components: gas sources, gas flow controllers, a gas manifold and distributor, a plasma chamber incorporating a heated substrate table and pressure monitoring, an rf generator, a pumping system including throttle valve, and an exhaust system. This is shown schematically in Figure 50. In commercial systems, gas flow control employs electronic mass flow controllers which can maintain absolute flows or fixed flow ratios, pressure monitoring is by species-independent capacitance manometers, and the pumping throttle valve is servo-controlled to maintain a constant chamber pressure. Many systems now employ microprocessor control.

It is the design of the plasma chamber itself, in particular the electrode and gas flow geometries, which distinguishes the various types of PECVD

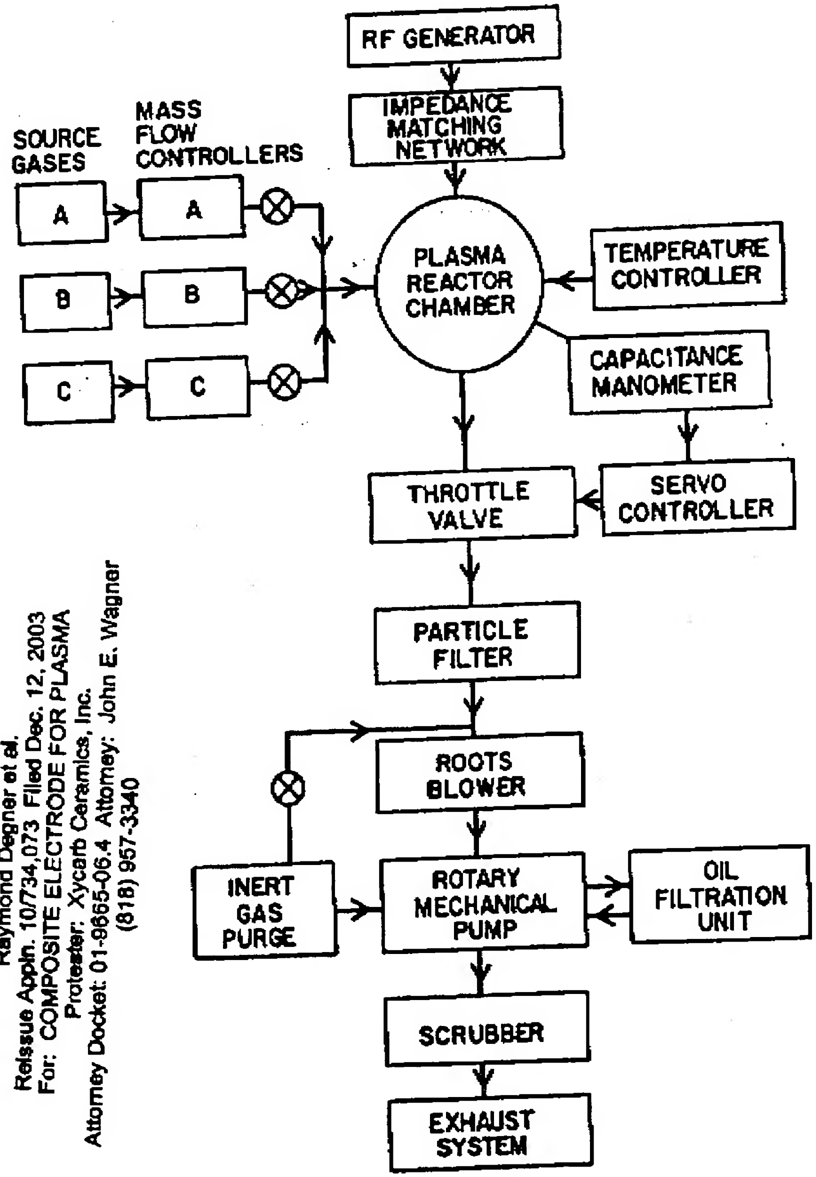
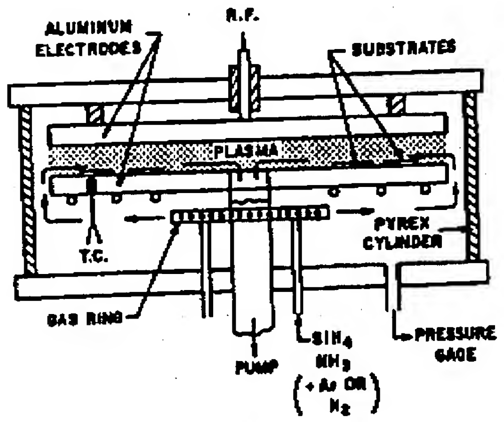


Figure 50: Schematic representation of the components of a PECVD system.

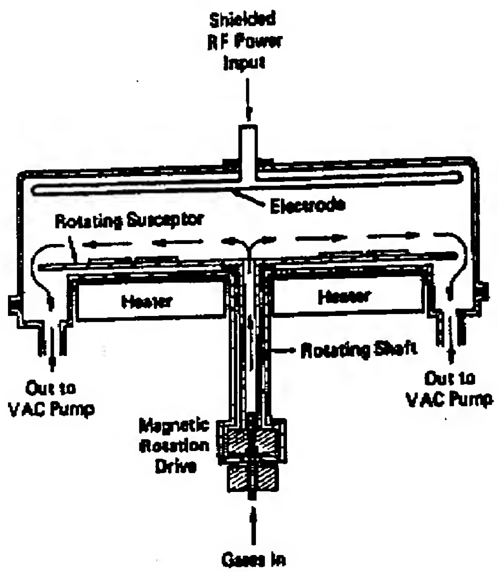
reactor. The three main categories are shown schematically in Figure 51, along with the relevant sub-categories. The class (c) shown is to son extent a sub-division of class (a) in that an individual pair of electrodes parallel-plate, but since multiple pairs of electrodes distributed in multip columns along a tube which is enclosed in a diffusion-style furnace a involved, it is a sufficiently different concept to merit separate descriptic

The parallel-plate, radial flow reactor shown in the first class w designed by A.R. Reinberg,[134,201] for silicon nitride deposition, and sometimes referred to as a Reinberg reactor. His original design [(a)(employed inward radial flow; a later variation,[202] using outward flow is al shown [(a)(ii)]. The radial-flow reactor is the most commonly employed f plasma deposition. Electrode diameters are usually in the range of 25 to 5 cm, and batch processing is used. Whereas single wafer processing h certain merits for plasma etching (see Section 3.2.3), it is not a viab alternative for plasma deposition due to deposition rates (for acceptab film properties) being rather lower than etch rates that can be employe The larger reactors are normally used for Si processing, and can accomoda about 20 four inch wafers. The smallest reactors are more than adequal for use in present III-V compound semicondutor technology. A typic process time from wafer loading to removal is about two hours, dependir on at what temperature it is permissible to laod wafers on to the substral table. If native oxide growth on the surface of a III-V semiconductor wafer to be avoided or at least limited, it is necessary that the substrate table b no more than a few tens of degrees above room temperature during waf loading. This can significantly increase process time, particularly in th case of the larger reactors with substrate tables of large thermal mass. Us of a wafer carrier plate to give a thermal delay slightly longer than th pump-down time circumvents this problem. The final variety of paralle plate reactor, shown in Figure 51 as (a) (iii), is the "shower head" variet which employs a perforated upper electrode through which the reactan gases are introduced into the plasma. An advantage of this scheme is tha the lower electrode (substrate table) is a continuous plate, in contrast t the annular geometry required for radial flow. A disadvantage is tha cooling of the perforated, powered electrode is difficult, sometimes neces sitating pulsed power plasma operation.

The second type of reactor is the tube or barrel reactor, into which the r power usually is inductively coupled, by a coil around the tube, external t the plasma region. This type of reactor is shown as (b) in Figure 51 Capacitive coupling via external electrodes is also possible. As before, th reactor is coldwall. This type of reactor is very simple and lends itself t process research studies, but is not suitable for uniform, batch depositio needed in a production environment. However, it is particularly suitable fo indirect plasma studies in which the substrate is not directly exposed t the plasma, but is mounted downstream from the glow region. In this wa reactive radicals and atoms, in both excited and ground states, can arriv at the heated substrate surface if their lifetime is sufficiently long. Sinc the substrate is in a field-free region, energetic ion and electron bombard ment is avoided. This is beneficial for avoiding or restricting substrate

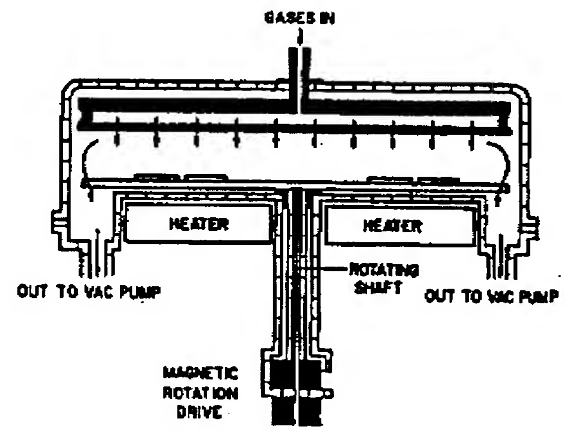


a i

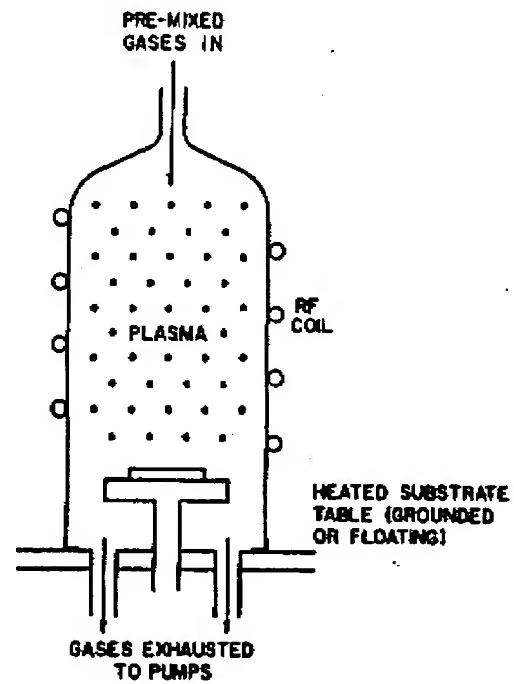


a ii

Figure 51: The main types of PECVD reactors (a) parallel-plate with (i) Reinberg-design inward radial flow (from Reference 183, reprinted with permission of the American Institute of Physics) (ii) modified Reinberg-design with outward radial flow (from Reference 202, reprinted with permission of *Solid State Technology*, published by Technical Publishing, a company of Dun and Bradstreet), (iii) shower head gas distribution (b) inductively coupled tube and (c) hot-wall (from Reference 203, reprinted with permission of *Solid State Technology*, published by Technical Publishing, a company of Dun and Bradstreet).



a iii



b

Figure 51: (continued)

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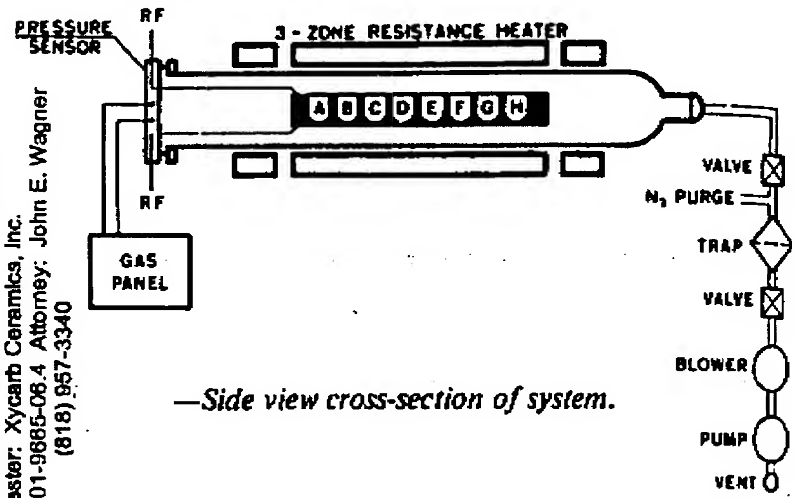
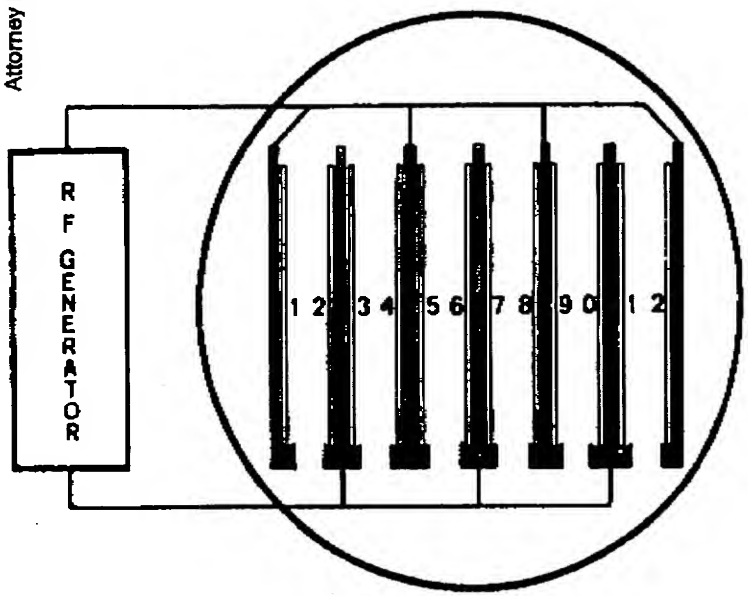


—*Side view cross-section of system.*



—*Front view cross-section of reactor internals.*

c

Figure 51: (continued)

damage effects, but may not be beneficial to film properties (see Sec. 4.2.4).

The final type of reactor is the hot wall tube,[203] shown as (c) in Figure 51. This is basically a diffusion furnace tube into which is inserted a multiple array of parallel-plate electrode pairs, usually made of carbon. Each grounded electrode can carry a single wafer in a vertical orientation. This arrangement is suitable for large, regularly shaped Si wafers, but is not suitable for the smaller and often irregularly shaped and sized III-V wafers. An advantage of this arrangement is its large wafer capacity; a commercially available system has a batch capacity of 84 four inch wafers. However in many applications its process cycle time is rather longer than that of the radial flow reactors. Since reactants are introduced at one end of the tube and both become depleted and are accelerated down a pressure gradient (thus reducing residence time) as they flow down the tube, it would appear that the only way to achieve uniform deposition is to use a large excess of reactants and hence operate at low efficiency, a possibly costly operation if very high purity SiH_4 is being used. One variation of this type of reactor[204] pulses the applied rf power to prevent downstream depletion of reactants. Commercially available PECVD reactors have recently been reviewed.[204]

A major reactor design consideration not yet discussed is the frequency of the rf plasma. The frequency range over which reactors have been operated (≈30 KHz to ≈30 MHz) can be split into two distinct regimes, as discussed in section 2.1. In one regime, which we will refer to as low frequency rf, both ions and electrons respond to the rf field. Thus in one half-cycle of the applied rf voltage, positive ions are extracted from the glow region and accelerated across the sheath above the substrates on the grounded table. Due to the fairly high pressure employed for PECVD (≈1 torr), most of these ions suffer collisions during acceleration through the sheath. Nevertheless, there is a flux of energetic ions incident on the substrate with an energy distribution whose high energy tail extends as high as the amplitude of the rf voltage, which may be a few hundred volts. This is illustrated in figure 10. The width of this energy distribution depends on pressure, gas species, rf power etc., and can be as large as a few hundred eV. It is this directional ion flux which is responsible for anisotropy and enhanced etch rates in low frequency plasma etching (see, for example, Reference 140), as discussed in Section 2.2.2.1. This regime of operation extends up to a few MHz, with the exact upper limit being determined by the ion masses, pressure, etc. Above this transition frequency, we are in the high frequency rf regime, in which the inertia of the ions prevents them from responding to the rf field which is followed only by the electrons. Although there is essentially no energetic (>50 eV) ion bombardment of the substrate, there remains a high flux of low energy ions (≈25 eV), as also shown in Figure 10 due to the small positive dc potential of the glow region, in addition to the energetic electron bombardment. This low energy ion bombardment is also present at low frequency. The difference in extent and energy of ion bombardment fundamentally changes bulk film properties, film/substrate interface properties and in some cases deposition rates.

All the types of reactors discussed can be operated at high or low frequency, although high frequency (13.56 MHz) is generally used for tube

United States Patent [19]

Wickersham

[11] Patent Number: 4,564,435

[45] Date of Patent: Jan. 14, 1986

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(818) 957-3340

[54] **TARGET ASSEMBLY FOR SPUTTERING MAGNETIC MATERIAL**

[75] Inventor: Charles E. Wickersham, Columbus, Ohio

[73] Assignee: Varian Associates, Inc., Palo Alto, Calif.

[21] Appl. No.: 738,205

[22] Filed: May 23, 1985

[51] Int. Cl.⁴ C23C 14/00

[52] U.S. Cl. .... 204/298; 204/192 R

[58] Field of Search .... 204/298, 192 R; 118/720, 721, 504, 505

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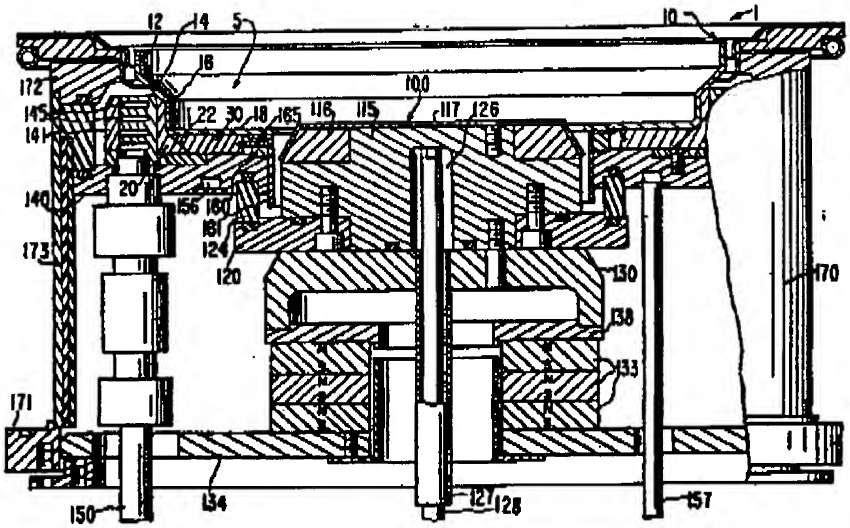
Primary Examiner—Andrew H. Metz
Assistant Examiner—Nam X. Nguyen
Attorney, Agent, or Firm—Stanley Z. Cole; David Schnapf

[57] **ABSTRACT**

An optimized annular sputter target assembly for use in sputtering magnetic material, comprising a thin target piece of magnetic material mounted on a backing structure of nonmagnetic material. Said backing structure provides means for easy mounting and removal of the target assembly and for providing good thermal and electrical contact with the cooling wall of the sputter source. The target piece has a portion extending radially outwardly from said cooling wall thereby providing greater target surface area.

8 Claims, 3 Drawing Figures



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United States Patent [19]

Horiuchi et al.

[11] Patent Number: 4,931,135
[45] Date of Patent: Jun. 5, 1990

[54] ETCHING METHOD AND ETCHING APPARATUS

[75] Inventors: Takao Horiuchi, Fuchu; Izumi Arai, Yokohama; Yoshifumi Tahara, Yamato, all of Japan

[73] Assignee: Tokyo Electron Limited, Tokyo, Japan

[21] Appl. No.: 287,156

[22] Filed: Dec. 21, 1988

[30] Foreign Application Priority Data

Dec. 25, 1987 [JP] Japan 62-333613
Jan. 25, 1988 [JP] Japan 63-14195
Jan. 25, 1988 [JP] Japan 63-14196
Jan. 25, 1988 [JP] Japan 63-14197
Feb. 9, 1988 [JP] Japan 63-29792
Mar. 7, 1988 [JP] Japan 63-53280

[51] Int. Cl.[5] B44C 1/22; H01L 21/306; C23F 1/00; C03C 15/00
[52] U.S. Cl. 156/643; 156/345; 156/646; 204/192.32; 204/298.35
[58] Field of Search .... 156/345, 643, 646; 204/298 E, 192.32, 192.35, 192.37; 427/38, 39; 118/50.1, 620, 728

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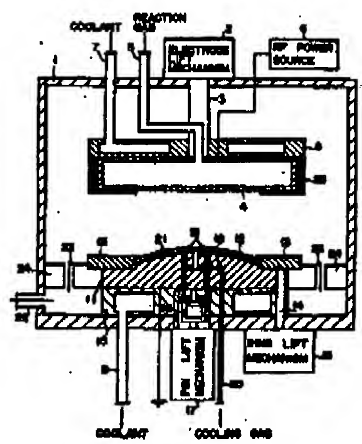
Primary Examiner—William A. Powell
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt

[57] ABSTRACT

A mounting surface of an electrode for mounting an object to be processed thereon is projected to be a curved surface identical to a curved surface obtained by deforming the object to be processed by a uniform load, and etching of the object to be processed is performed. Etching of the object to be processed can be easily and stably performed, thereby improving yield and productivity.

21 Claims, 10 Drawing Sheets



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(818) 957-3340

United States Patent [19]

Rose

[11] **Patent Number:** 4,820,371

[45] **Date of Patent:** Apr. 11, 1989

[54] **APERTURED RING FOR EXHAUSTING PLASMA REACTOR GASES**

[75] Inventor: Alan D. Rose, Wylie, Tex.

[73] Assignee: Texas Instruments Incorporated, Dallas, Tex.

[21] Appl. No.: 132,306

[22] Filed: Dec. 15, 1987

[51] Int. Cl.⁴ B44C 1/22; C23C 14/00

[52] U.S. Cl. 156/348; 118/50.1; 118/620; 118/728; 156/643; 156/646; 204/298

[58] Field of Search 118/728, 50.1, 620; 204/192.12, 192.32, 192.3, 298; 156/345, 643, 646; 427/38, 39

[56] References Cited

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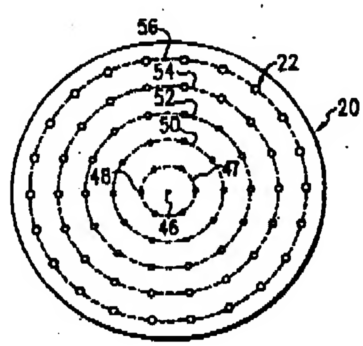
Primary Examiner—William A. Powell
Attorney, Agent, or Firm—Joseph E. Rogers; James T. Comfort; Melvin Sharp

[57] ABSTRACT

An annular ring (38) adapted for use in a plasma reaction chamber. The annular ring (38) includes a central opening aperture for laterally retaining a semiconductor slice (40) within the chamber. Spaced around the ring are a plurality of gas exhaust ports (58) for providing a back pressure within the chamber, for removing gases therefrom. Different rings can be provided with different central opening apertures to accommodate the processing of different sized slices. Alternative arrangements of the ring (38) provide for mask openings (68) to mask selected areas of the slice (40) and prevent plasma reactions thereat.

18 Claims, 2 Drawing Sheets



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United States Patent [19]
Loewenstein et al.

[11] Patent Number: 4,904,621
[45] Date of Patent: Feb. 27, 1990

[54] REMOTE PLASMA GENERATION PROCESS USING A TWO-STAGE SHOWERHEAD

[75] Inventors: Lee M. Loewenstein, Plano; Cecil J. Davis, Greenville, both of Tex.

[73] Assignee: Texas Instruments Incorporated, Dallas, Tex.

[21] Appl. No.: 74,371

[22] Filed: Jul. 16, 1987

[51] Int. Cl.⁴ H01L 37/32
[52] U.S. Cl. 437/225; 437/39; 118/50.1; 118/620; 118/728; 156/643; 156/646
[58] Field of Search 437/33.1, 38, 39; 156/643, 646, 657, 656; 422/199; 118/728, 50.1, 620; 437/225

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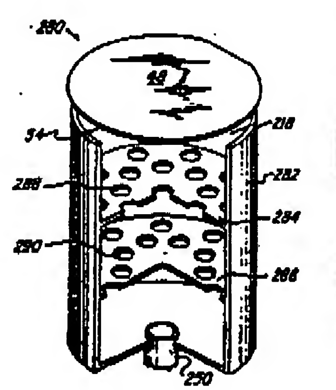
(List continued on next page.)

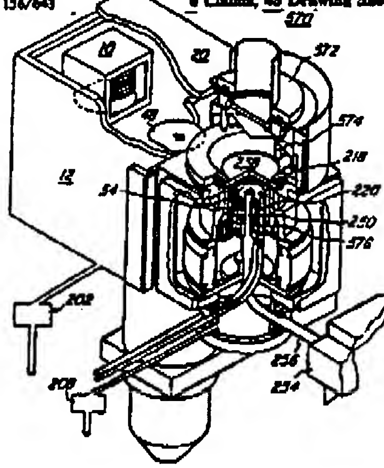
Primary Examiner—Brian E. Hearn
Assistant Examiner—Beverly A. Pawlikowski
Attorney, Agent, or Firm—Gary C. Honeycutt; Melvin Sharp; Rhys Merrett

[57] ABSTRACT

A processing apparatus and method for performing a descum process (i.e. a process for removal of polymers and other organic residues) which uses a remote plasma, supplied through a distributor which includes a two-stage showerhead, to achieve improved results.

4 Claims, 43 Drawing Sheets





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156-121 59

1/4/83 XR 4,367,114

United States Patent [19]

Steinberg et al.

[11] 4,367,114

[45] Jan. 4, 1983

[54] HIGH SPEED PLASMA ETCHING SYSTEM

[75] Inventors: George N. Steinberg; Alan R. Reinberg, both of Westport; Jean Dalle Ave, Stamford, all of Conn.

[73] Assignee: The Perkin-Elmer Corporation, Norwalk, Conn.

[21] Appl. No.: 260,668

[22] Filed: May 6, 1981

[51] Int. Cl.³ C23C 15/00

[52] U.S. Cl. .... 156/345; 156/643; 204/192 E; 204/298; 239/145; 219/121 PD; 219/121 PG

[58] Field of Search .... 156/345, 643; 204/192 E, 298; 222/3; 219/121 PD, 121 PG; 239/145

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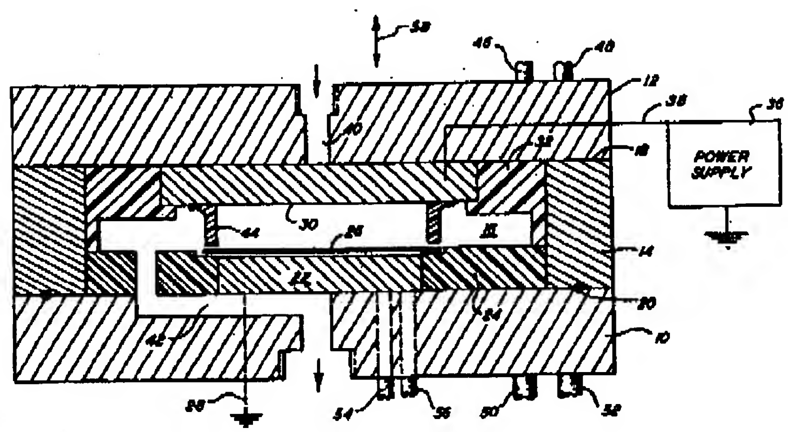
Primary Examiner—Jerome W. Massie
Attorney, Agent, or Firm—S. A. Giarratana; E. T. Grimes; T. P. Murphy

[57] ABSTRACT

This invention relates to a plasma etching system, which includes a lower flange and a spaced upper flange; a chamber wall mounted between the flanges to form a closed etching chamber; a grounded wafer support plate disposed in said chamber for receiving thereon a wafer to be processed; an electrical insulating element interposed between the chamber wall and the support plate; a sintered or sintered-like porous electrode plate mounted in the chamber in spaced relationship with respect to the wafer; said plate having a gas inlet for receiving a supply of etching gas; circuitry for applying an excitation voltage to this plate, and said chamber having a gas outlet leading to a vacuum source.

28 Claims, 1 Drawing Figure



REISSUE LITIGATION
Raymond Degner et al.
Reissue Appln. 10/734,073 Filed Dec. 12, 2003
For: COMPOSITE ELECTRODE FOR PLASMA
Protester: Xycarb Ceramics, Inc.
Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

United States Patent [19]

Mundt et al.

[11] **4,297,162**

[45] **Oct. 27, 1981**

[54] **PLASMA ETCHING USING IMPROVED ELECTRODE**

[75] Inventors: **Randall S. Mundt**, Houston; **Timothy A. Wooldridge**, Missouri City; **Thomas O. Blasingame**, Houston, all of Tex.

[73] Assignee: **Texas Instruments Incorporated**, Dallas, Tex.

[21] Appl. No.: **85,564**

[22] Filed: **Oct. 17, 1979**

[51] Int. Cl.³ H01L 21/306; C23F 1/00

[52] U.S. Cl. .... 156/643; 156/345; 156/646; 204/192 E; 204/298; 250/531

[58] Field of Search .... 219/121 PA; 250/531, 250/539; 204/164, 192 EC, 192 E, 298; 156/345, 643, 646, 656, 657; 313/231.3, 348

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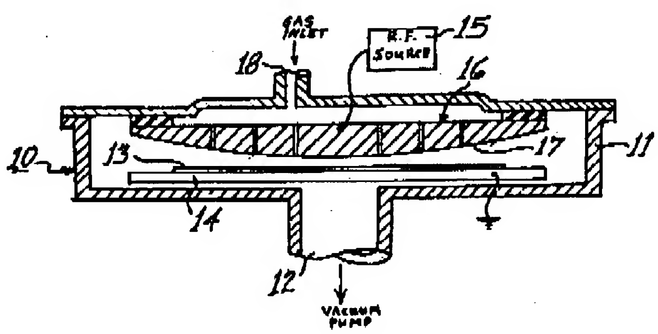
Primary Examiner—William A. Powell
Attorney, Agent, or Firm—John G. Graham

[57] **ABSTRACT**

Radio frequency plasma etching of conductive coatings on semiconductor slices is improved by the use of a curved electrode which is closer to the slice at the center than at the periphery. Preferably, the electrode is in a symmetrical chamber which contains only one slice, and reactant gases are admitted through apertures in the electrode. An r.f. power source is connected between the electrode and a holder for the slice.

14 Claims, 5 Drawing Figures



REISSUE LITIGATION
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Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

United States Patent [19]

Rose et al.

[11] Patent Number: 4,792,378

[45] Date of Patent: Dec. 20, 1988

[54] GAS DISPERSION DISK FOR USE IN PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION REACTOR

[75] Inventors: Alan D. Rose, Wylie, Tex.; Robert M. Kennedy, III, Taylors, S.C.

[73] Assignee: Texas Instruments Incorporated, Dallas, Tex.

[21] Appl. No.: 132,305

[22] Filed: Dec. 15, 1987

[51] Int. Cl.⁴ B44C 1/22; B05B 5/02; C23C 14/00; C03C 15/00

[52] U.S. Cl. 156/643; 118/50.1; 118/728; 118/620; 156/345; 156/646; 204/192.12; 204/298; 427/38

[58] Field of Search 156/345, 643, 646; 118/728, 50.1, 620; 204/192.12, 192.32, 192.3, 298; 427/38, 39; 422/186.05, 186.06

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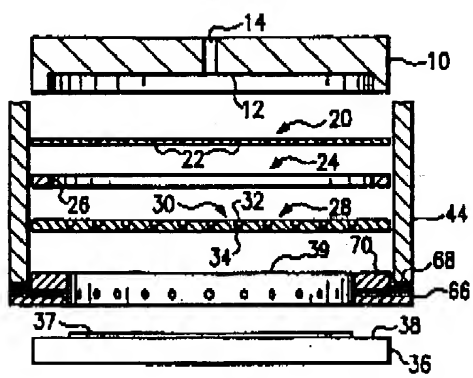
Primary Examiner—William A. Powell
Attorney, Agent, or Firm—Frederick J. Telecky, Jr.; Thomas W. DeMond; Melvin Sharp

[57] ABSTRACT

A chemical vapor transport reactor gas dispersion disk (20) for counteracting vapor pressure gradients to provide a uniform deposition of material films on a semiconductor slice (37). The disk (20) has a number of apertures (22) arranged so as to increase in aperture area per unit of disk area when extending from the center of the disk (20) to its outer peripheral edge.

22 Claims, 1 Drawing Sheet



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REISSUE LITIGATION
Raymond Degner et al.
Reissue Appln. 10/734,073 Filed Dec. 12, 2003
For: COMPOSITE ELECTRODE FOR PLASMA
Protester: Xycarb Ceramics, Inc.
Attorney Docket: 01-9665-06.4 Attorney: John E. Wagner
(818) 957-3340

United States Patent [19]

Hidler et al.

[11] **Patent Number:** 4,544,091

[45] **Date of Patent:** Oct. 1, 1985

[54] **TARGET BONDING PROCESS**

[75] Inventors: Henry Hidler, Danvers; Ernest Davey, Peabody; Lawrence L. Hope, Stow; Robert Skinner, Topsfield, all of Mass.

[73] Assignee: GTE Products Corporation, Stamford, Conn.

[21] Appl. No.: 617,159

[22] Filed: Jun. 6, 1984

Related U.S. Application Data

[63] Continuation of Ser. No. 375,625, May 6, 1982, abandoned.

[51] Int. Cl.⁴ B23K 31/02
[52] U.S. Cl. 228/124; 228/708; 228/903
[58] Field of Search 228/903, 121, 122, 124, 228/208, 209

[56] **References Cited**

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Primary Examiner—Kuang Y. Lin
Attorney, Agent, or Firm—William H. McNeill; José W. Jimenez

[57] **ABSTRACT**

A process for bonding one or more target parts, such as yttrium oxide target parts, to a copper backing plate to provide improved mechanical support and improved heat transfer. The process is one in which a noble metal, preferably platinum, is applied to the target to provide an oxide free layer to which indium/lead solder joins. The solder step is performed so that contamination by flux or by formation of an oxide is prevented.

11 Claims, 2 Drawing Figures